5. THE MANUFACTURE OF THE TERO-WATTA.

By Fritz Noetling, M.A., Ph.D.

Pl. V., VI., VII., VIII.

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1. GENERAL AND HISTORICAL REMARKS.

Recent investigations have proved that the aborigines obtained the siliceous rocks used in the manufacture of their stone implements from two sources, viz.:—

1. From certain localities where such kinds of rocks occur in situ (1).

2. From the gravel deposits of pleistocene and modern age, in the shape of waterworn boulders.

The former localities have very aptly been termed "native quarries," but it appears that, though these quarries were extensively worked, the material obtained from this source was not of the same importance as that obtained from the gravel beds. Among the specimens collected at Melton Mowbray only 6.1 per cent. could with certainty be identified with the rock occurring in Johnston's quarry, and about 8 per cent. were manufactured from rock found in Nichols's quarry, west. The total of tero-watta made from locally occurring rock, therefore, does not exceed 14 or 15 per cent. Among the Mona Vale specimens 11.3 per cent., and among those from Mount Morriston-Trefusis 7 per cent. were made from rock occurring at Hutchison's quarry. I have been very careful in identifying the nature of the rock, yet there may be mistakes, but on the whole I consider these figures rather above than below the mark.

We, therefore, see that at the outside 15 per cent. of the tero-watta were manufactured from rock obtained in

(1) Noetling.—The native quarry on Coal Hill, near Melton Mowbray. Tasman. Naturalist, vol. 1., No. 2, Sept., 1907.

Noetling. The native quarry of Syndal, near Ross. Paper and Proceed. Roy. Soc., Tas., 1908.

quarries, while 85 per cent. were manufactured from rocks otherwise obtained. It is very difficult to account for this peculiarity. Johnston's and Nichols's quarries are very conveniently situated near the camping ground of Melton Mowbray, and the same applies to Hutchison's quarry with regard to the camping ground, Mona Vale. Therefore, it cannot be distance that prevented a more extensive use of the quarry rock. We also know that the quarries were intensively worked, as hundreds of thousands of broken fragments conclusively prove. As all the fragments now found at the quarries must be considered as unsuitable rejects, we must assume that the rock obtained in situ was not very suitable for the manufacture of stone implements, otherwise there would not have been such an enormous amount of refuse. To me it seems that the rock obtained from gravel beds possessed certain qualities which the rock obtained from quarries lacked to a great extent. As the most essential quality is a good, smooth fracture, it appears probable that the same kind of rock when obtained from gravel beds had a better fracture than if obtained in situ from a quarry.

The second source from which suitable rocks were obtained are the numerous gravel beds either in the modern rivers, or of earlier geological age. The examination of thousands of tero-watta has conclusively proved that by far the greater majority represent flakes struck off from water-worn pebbles. Such pebbles have been found in all stages of operation. We find pebbles from which one or perhaps two flakes were struck off, tentatively, as it would seem, while dozens or more flakes were struck off from others. For instance, not less than 13 flakes were struck off a portion of a pebble now weighing $14\frac{1}{4}$ ounces, found near Rokeby, and more than 11 from the Kempton nucleus. My investigations have conclusively proved that the aborigines preferred the rock obtained in the shape of a water-worn pebble to that found in quarries, even if such quarries were situated close to a camping ground. As above stated, I believe that the reason for this preference was the better, cleaner fracture of the water-worn pebbles. We might expect that a piece of rock which has been subjected to the process of being rolled and worn by a torrential current must be of good quality to withstand all this wearing down process. It would appear probable that such a pebble yielded better flakes than a piece of rock picked up in a quarry, whose strength had not been previously submitted to severe tests.

However that may be, the main fact, viz., that the aborigines chiefly obtained the material for the manufacture of the tero-watta in the shape of water-worn boulders and pebbles from the gravel beds of the island remains undisputable. It would be of the greatest interest to know whether archæolithic man of Europe preferred in a similar way flint pebbles found in gravel deposits, to flint obtained directly from the chalk. This question is, however, somewhat complicated, considering the nature of the flint nodules, and I refrain from expressing an opinion.

Now, how were the tero-watta manufactured? The answer to this question is more difficult than it appears, and we will first see whether the historical accounts help to solve the problem. I can only find two references bearing on this question. Scott (1), to whom we are indebted for a great number of important observations, states that he watched an aborigine for over an hour "chipping one flint with another, so as to give them the peculiar cutting sharp edges."

A further observation is contained in Walker's (2) account of the quarry at Plenty. One of the early colonists by the name of Rayner met between 1813 and 1818 a "mob" of aborigines who were busily engaged breaking stones at Walker's quarry. "They were breaking the stones into fragments either by dashing them on the rock or by striking them with other stones, and picking up the sharp-edged ones for use." One old fellow he describes as dashing his stone upon another one on the ground, and leaping up and spreading his legs out at the same time, to avoid as much as possible being struck by the splinters.

This is all I could find concerning the manufacture of the tero-watta, and little enough it is. That a tero-watta was wrought by striking the raw material with another stone is a priori very probable, and the only point of interest in Scott's statement is the length of time. For an hour or so, Scott says, the aborigine was striking the flint, and we may presume, one and the same specimen. Rayner's statement, interesting as it is, does not contain much information either, larger pieces can probably be reduced in size by dashing them against a rock, and if convenient spalls came off they were picked up with the view of shaping them afterwards. The breakage of larger blocks, by dashing them against a hard surface is, therefore, not an

(1) Monthly Notes of Pap. and Proceed. Roy. Soc., Tas., July, 1873, page 24.

(2) Ling Roth, aborigines of Tasmania, 2nd edition, page 149.

essential feature in the manufacture of tero-watta, but merely a preliminary one, to obtain suitable pieces.

We have, therefore, no other means of finding out how the tero-watta were manufactured than the study of the traces the process of manufacture left behind. These are numerous enough, but it required a large number of tero-watta to collect sufficient evidence, and to sort it. From the account of an actual eye-witness (1), we know that two stones were required for the manufacture of a tero-watta, viz.:

1. A piece of (siliceous) rock which was to be turned into an implement.

2. Another stone to strike the former with.

In other words, a hammer-stone and an object-stone. The hammer-stone was actively employed, that is to say, it was used to deliver the blows; the object-stone was passively employed, that is to say, it was subjected to the blows delivered with the hammer-stone.

The object-stone may be of two kinds; it was either a natural pebble, or boulder of siliceous rock, which we may term the parent block, or it represented a flake struck off the parent block. Primarily we may take it that the object-stone was represented by a natural block or boulder, and the effect of a well-directed blow was to divide the parent block into flake and nucleus. (2).

All this appears to be very plain and simple, yet if we come to examine a larger number of tero-watta we at once observe specimens, which are difficult to classify. Are they hammer-stones, or do they represent nuclei? Are they to be considered as unfinished rejects, or as nuclei? It is obvious that it makes a great difference whether I consider a specimen as an actively used hammer-stone or as a passively used nucleus, and yet in many instances it is almost impossible to say which is which. Furthermore, if we consider that it is often enough impossible to discern a true hammer-stone from a sacred stone, or the latter from an anvil-stone, the great difficulties are obvious.

I will here attempt to solve these problems by studying the evidence handed over to us on the actively and passively used objects, that is to say, hammer-stone and object-stone.

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(1) Scott l.c.

(2) See also: The effects of percussion on siliceous rocks

2. EVIDENCE OF THE HAMMER-STONES.

It seems easy enough to discern a hammer-stone. Rutot has so well described the marks produced by blows that it seems almost ridiculous to be in doubt whether a stone is a hammer-stone or not. Yet, if we collect a large number of specimens considered to be hammer-stones, we perceive at once that the matter is by no means so easy. The definition of the hammer-stone requires that it should be actively used, but we find specimens which show, from the position of the marks of blows, that they could not possibly have been used actively, but that they were subjected to blows, in other words, used passively, and that they, therefore, cannot represent hammer-stones. Marks of blows alone do not characterise a stone as a hammer-stone, a fact that has been conclusively proved by the study of a large number of specimens.

A stone showing marks of blows may be—

(1) A true hammer-stone.

(2) A tested pseudo-nucleus.

(3) A sacred stone.

(4) An anvil-stone.

The great difference between these four groups is obvious, yet it is not always possible to say to which group a certain specimen belongs, so imperceptibly are they merging into each other. It may, perhaps, be possible to discern in future between the marks of active and passive blows, that is, to know whether a specimen showing marks of blows was actively used as a hammer stone, or passively subjected to blows as an object stone, but for the present there is no criterion to discern these marks.

There are, however, other features which will assist us to discern true hammer-stones. It is almost pretty certain that in order to break a larger boulder of siliceous rock, no other than diabase pebbles were employed. This seems a priori very probable. Diabase is a tough rock, chert, hornstone, or the other siileeous rocks used in the manufacture of tero-watta are brittle, and break easily. If, therefore, a siliceous rock were used as hammer, in order to break another siliceous rock, it might happen that the hammer, but not the object-stone broke.

It is, therefore, more than probable that all these stones of that kind from which the tero-watta were manufactured, viz., chert, hornstone, porcellanite, breccia, showing marks of blows, cannot be considered as hammer-stones, but must be considered as tested and rejected parent blocks (pseudo-nuclei).

This limits our field of research to some extent, as we have to consider the diabase boulders or pebbles only. Now, among this class there are a certain number which form a most conspicuous group. These are generally very regular, oval, flat pebbles, showing in the centre of either both or one face only a rough indentation or mark. The edge shows either marks of blows all round, or else at the two poles only, or at the two poles and in the middle of the two longitudinal sides. Frequently the formerly rounded edge is flattened by grinding. These stones have been considered as typical hammer-stones, a view with which I cannot agree. It would lead too far to discuss here my reasons, and I must refer the reader to a preliminary paper on this subject. (1).

It is certainly very remarkable that only a few specimens of this type have been found which are not made of diabase, but of a very hard splintery quartzite. It is further noteworthy that not one of these stones has been found in a quarry, while ordinary hammer-stones are very common. Now, if these stones were hammer-stones, why were they not used in the quarries where they were certainly urgently required? Why are they only found on camping grounds?

If we exclude this group, there remains only a small group of stones which must be considered as hammer-stones. Yet even among these there are a number, particularly when found on camping grounds, which appear very doubtful as to their true character. They may be hammer-stones, yet there is a probability that they either represent unfinished sacred stones or a special group of the latter. A further discussion of this question must form the subject of another paper.

Here I will deal only with those specimens of which I am certain that they were used as hammer-stones. These are the diabase pebbles found among the rejects in the native quarries (2). There cannot be the slightest doubt that

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(1) Noetling.—Some implements of the Tasmanian aborigines, the magic stones, Tasman. Naturalist, vol. I., No. 3, December, 1907, page 1.

(2) See also J. B. Walker, the Tasmanian Aborigines, Hobart, 1900 page 8.

these diabase boulders were used as hammer-stones. In the first instance they are very battered, and almost every one is in a fragmentary, broken condition. The presence of such diabase boulders among thousands of broken fragments of hornstone is the surest sign that they were carried to their present resting place by human agency. Their battered condition proves that they were used for some heavy work, and the only conclusion we can draw from their nature is that they were used as hammer-stones. I weighed 17 specimens of these hammer-stones, which I collected at Nichols's quarry, the weights ranging from 5¼ ounces to 1lb. 5oz. As all the specimens lost considerably during use, their original weight must have been higher, but it is rather difficult to say anything about the loss. Only six out of the 17 exceeded one pound in weight, but as seven more weigh from 12 to 15 ounces, it is pretty safe to say that in their original state these stones weighed from 1lb. to 2lb.

Now, if we examine these hammer-stones we find that they all show a more or less spherical or globular shape. Not in a single instance have I found one of the flattened, oval type, showing rough indentations in the centre of either or one side only. We might well ask why is it that if this last-named group of stones were hammer-stones, they were used at the camping grounds only, and not at the quarries? The hammer-stones had to be brought to the quarry, and the evidence of the specimens proves that they were globular diabase boulders, probably water-worn pebbles. Now, if it was found necessary to provide the so called hammer-stones with a mark for the insertion of the thumb and another finger, why were the unquestionable hammer-stones of the quarries never provided with these marks?

The evidence of those specimens whose use as hammer-stones is beyond doubt, goes to prove the following facts:—

1. Diabase pebbles only, and no other kind of rock, were used as hammer-stones.

2. It appears that the essential feature of such a pebble to serve as hammer-stones was its spherical or globular form. (1). Compressed or flattened pebbles were apparently never used as hammer-stones.

3. The great majority of the hammer-stones weighed from 1lb. to 2lb., though, of course, there may be heavier

(1) See also antea, page 43.

and lighter ones, but boulders of that weight were apparently the most serviceable.

4. These boulders were used witnout any previous treatment; in fact, they may be considered as true "eolithes."

5. The compressed diabase pebble of oval shape, showing various marks of blows along the edge, and a central rough indentation on either one or two sides, cannot be considered as hammer-stones, whatever else their use or meaning may have been.

3. WERE ANVIL-STONES USED IN THE MANUFACTURE OF THE TERO-WATTA?

Dr. Rutot, in his important paper, "Un Grave Probleme" (1) thinks that he can distinguish anvil-stones among the collection of specimens I sent him, but I am afraid that, as far as the specimen so designated is concerned, I cannot agree with him. I have not found a single flake which I could declare as an anvil-stone, and it will, therefore, be useful to discuss the question whether anvil-stones were ever used at some length.

The accounts of eye-witnesses are silent on this point. Scott does not state that the "flint" which was chipped with another rested on another stone, viz., an anvil. In fact, his statement almost seems to imply that the flint which was chipped, was held by one hand, while the other wielded the hammer. We are, therefore, obliged to study the tero-watta in order to ascertain whether they bear traces of having rested on an anvil-stone or not. It is pretty certain that if a piece of hornstone rests on a hard support, while it is hammered at, those portions of its surface that have been in contact with the hard support, must become somewhat dulled. Now, as we know that the tero-watta were wrought by blows that were directed from the Pollical face towards the Indical face, a flake must have rested on its Indical face while the process of trimming it was performed, if an anvil-stone was used. The traces of having rested on a hard support should, therefore, be found on the Indical face, but the result of such an examination is absolutely negative. Among the thousands of specimens I examined, there is not one whose Indical face shows marks of having rested on a hard support. All edges are exceedingly sharp,

(1) Bull. Soc. Belge de Geol, Palæont et Hydr, vol. XXI., 1907.

in fact, it is difficult to imagine how some of the specimens could exhibit and preserve such a fine Indical face, unless the flake was held in the free hand, while the other wielded the hammer.

The evidence of the tero-watta themselves, therefore, goes to negative the assumption that an anvil-stone was used when they were made.

As far as the evidence of the Kempten nucleus and its spalls goes, it seems to indicate that it did not rest on another stone or hard support while it was broken, but was probably mostly imbedded in the soft sand of the camping place. The Kempton nucleus does not support the theory of the use of anvil-stones, and the arguments in favour of its use at all are not very strong. It would be ludicrous to assume that the Kempton boulder was broken at some other place affording a hard natural surface as support, and that afterwards the core and all the flakes, even the smallest, were brought to the camping ground simply to be left there. If anything appears to be certain it is that the Kempton boulder was broken at the place where its fragments were subsequently found, but there is no proof that it rested on a hard support.

Now, if any supports whatever were used—and if we admit the præmisse we must assume that they were habitually used—where are they? If they existed they must be recognisable, because if a hard boulder is broken on a hard surface, the effect of the blows which broke it must also leave some marks on the support when the boulder rebounded under the effect of the heavy blows.

I have passed the whole inventory list of the specimens found on the camping grounds and elsewhere, and the only objects that could possibly come in consideration are those I have described as "magic stones." The flatness of these pebbles would render them very suitable as a support. The queer central indentations could be considered as the result of the rebounding of the block to be broken (1) and the peripheral hammering would result from the hammer-stone striking or touching the anvil-stone.

This theory would in some way explain the great variety of these remarkable stones, and also why they are

(1) When the stone was turned over the indentation on the opposite side would be produced.

never found in quarries, where the natural surface afforded a good hard support. Yet there are such a number of very weighty arguments against this view that I am not inclined to accept it, unless convincing evidence is forthcoming. In the first instance, it seems to me, that if a hard boulder is broken on another, the marks which the former left on the latter ought to be spread all over the surface, and not to be concentrated in a central space of a few millimetres in diameter (1). Further, if the peripheral marks are those of the hammer, how is it that they so frequently occur only on four opposite points, and why are they, particularly those on the longitudinal side, frequently flattened, just as if the edge had been ground? It is true that specimens occur whose edge is hammered, or even flattened all round, but often enough these specimens are without central marks. Another important point is the comparative smallness of these boulders. I cannot well imagine how a boulder of the size of the Kempton one rested on one of these small, flat pebbles while it was broken. Further, why should these anvil-stones so frequently be polished, even actually ground, like the specimen from the Old Beach? Is it probable to assume that the aborigines bestowed more labour on their anvil-stones than on the implements themselves, which were in the last instance the desired object of all the hard labour applied? All these are such weighty arguments against the theory of the indented pebbles to be taken as anvil-stones that I do not feel inclined to accept it. Yet, if anvil-stones were used at all, there are no other objects known but those stones that could have served for such a purpose.

However that may be, if anvil-stones were used at all, they were not represented by flakes of hornstone split off from a parent block, as Dr. Rutot assumes. In Europe such flat pieces or slabs of flint may have served as anvil-stones, but not in Tasmania. We have here no similar pieces of hornstone, and the anvil-stone such as mentioned by Dr. Rutot would first have to be manufactured. For the present there is little or no evidence to show that anvil-stones were used in the manufacture of the tero-watta. The only evidence, viz., that of the implements themselves, goes to prove the contrary, and I, personally, feel inclined to discredit the alleged use of anvil-stones altogether.

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(1) There are no doubt some specimens which show the marks of blows all over the surface, but I cannot understand how the central indentation could originate while the surrounding surface remained perfectly smooth.

4. THE EVIDENCE OF THE NUCLEI OR CORES.

What constitutes a nucleus or core? The answer seems simple enough: any piece of rock that remains after one or more flakes were struck off represents a nucleus or core. The study of the tero-watta has, however, shown that it is not always easy to distinguish between a nucleus and an unfinished reject, that is to say, a flake that was struck off a parent block, but was not finished. Further, other specimens have been found which conclusively prove that though one or even more flakes were struck off, they cannot strictly be considered as cores. These specimens were apparently only tested as to the suitability of the rock. At Droughty Point I found a splendid specimen of this type, and a large number of these remarkable specimens were found at Devonport, but the most interesting of all came from Shene.

There is no sharp, well-defined limit between nucleus, pseudo nucleus, and unfinished reject. They pass so imperceptibly into each other that it is often absolutely impossible to decide which type a certain specimen represents. On the other hand, if a large number is collected, there will always be a few specimens which leave no doubt as to their nature.

I will, therefore, deal with the evidence of such specimens only which leave no doubt as to their character, taking the nuclei or cores first.

(A) NUCLEI.

Though a number of specimens have come under my notice which must unquestionably be considered as nuclei, none is so convincing and absolutely certain as the Kempton nucleus (1).

I found this specimen on the eastern slope of a hill north of Kempton known as the Sisters, and I first discovered, what we may now term the core, representing, apparently, about half of a large water-worn pebble. I also found 41 flakes which could all be fitted to the core, and the most interesting of all was the last flake that was struck off the core, of which I had previously made a cast. The

(1) Notes on a chipped boulder found near Kempton. Pap. and Proceed. Roy. Soc., Tas., 1908.

core weighs 5lb. 10oz., the total of the 41 flakes is 2lb. 15oz.; core and flakes weigh, therefore, 8lb 9oz. in the aggregate, but as the top portion is still missing, the weight of the original boulder was probably not less than 10lb.

The spalls that were struck off this boulder exceed more than 41, and vary considerably in size and weight. We can distinguish external and internal flakes, and the last one that was struck off a typical internal flake of the 1st order weighs almost 4 ounces. All further work was stopped after this flake had been struck off, and we must, therefore, consider it as the desired object. This view is further borne out by the fact that many of the flakes previously struck off seem by the sharpness of their edges eminently suitable as implements, yet they were disregarded.

Unless we believe the very improbable theory that an aborigine amused himself by striking off about half a hundred of spalls from a parent block with no object at all, we must take it that the object of all this hard work was the production of a flake of either certain weight or shape, or of both. So far no evidence has been found that the shape of a flake was material, and we must, therefore, assume that it was desired to produce a tero-watta of a certain weight, and as weight is dependent on the size, we might also say of a certain size.

It may seem somewhat rash to generalise from one specimen only, but the Kempton nucleus seems to prove that whenever a pebble of suitable rock was broken, it was with the view of obtaining a flake of a desired weight (and size). All others were disregarded, no matter how suitable they may appear to us. This view is borne out by the evidence of the quarries. I have repeatedly pointed out that it appears unintelligible that such a number of apparently eminently suitable flakes were rejected, while others that seem to us much less suitable were used. There is only one explanation for this fact, viz., that the primary object was to obtain a flake of a certain weight (or size). Sometimes a larger, sometimes a smaller, flake may have been wanted, but, however suitable the other flakes that fell off may have been, they were disregarded.

(B) THE TESTED REJECTS (pseudo-nuclei).

As stated above, there is another group of pebbles and boulders which has been subjected to a certain amount of hammering, which cannot be considered as hammer-stones, or as nuclei, strictly speaking.

Mostly one, sometimes two, and in very rare cases more flakes were struck off such a pebble, but the remainder was left intact. It is certainly by no means accidental that, with very few exceptions, all these pebbles consist of a more or less saccharine quartzite of varying colour. Fine specimens of this type were found at Devonport, the Arthur River, at Shene, and Droughty Point.

These specimens always show at the point where the flake was struck off a peculiar percussion mark. This is usually a small semi-circular indentation of about 5 mm. in diameter, which deeply penetrates into the matrix of the pebble. Within the area of percussion the matrix is so intensely pulverised that the surface assumes a whitish colour. Almost in all cases a flake of greater or smaller size became detached, though in one specimen from Devonport the result of the blow was a deep roundish hole only. As already stated, there are usually one or two, but very seldom more than two, of these percussion marks.

Now, the question would arise, are these pebbles to be considered as hammer-stones or not; in other words, were they actively used or passively subjected to blows? I do not think that they can have served as hammer-stones. The evidence of the true hammer-stones shows that they were used till they broke into fragments. Now, if these stones were used as hammers, why was there only one, perhaps two, points used, while the remainder of the edge remained perfectly intact? To me it seems extremely improbable that one or, perhaps, two, blows were executed with such a stone, which was afterwards thrown away, though it was perfectly intact along the greater portion of its edge. Further, I cannot believe that the deep percussion mark, showing an intensely pulverised surface, is the result of an active blow. Such a mark can only be produced if a pebble is passively subjected to a blow, and I, therefore come to the conclusion that it is impossible to suppose that pebbles of this type served as hammer-stones.

Neither do I think that these pebbles can be considered as nuclei s.s. If they were such, why should only one or two flakes have been struck off, if the rock was suitable for the manufacture of implements? I rather think that they must be considered as material that was tested as to its suitability, and on being found unsuitable, were rejected.

When material was required boulders from the gravel beds were collected, and it is more than probable that among a number of them there were a certain number, which, though seemingly hard and suitable, were really unsuitable. These boulders were tested by striking off one or two flakes, and if they were found lacking that essential quality for the production of a tero-watta, viz., a good conchoidal fracture, they were rejected. It is by no means surprising that almost all of these rejects are pebbles of saccharine quartzite, which does not fracture like the homogeneous hornstone.

The astonishing part, however, is that the aborigines ever did collect such quartzite pebbles. One ought to assume that long experience taught them to distinguish a quartzite boulder from a hornstone boulder. But what is more, one detached flake ought to have been sufficient to prove the suitability of the material or not. Yet frequently two, three, or as in the instance of the Shene pebble, somo six tests were made before it was finally rejected. This is again one of those psychological problems that we so frequently meet in our studies of the civilisation of the Tasmanian aborigines.

A modern mind would soon learn to distinguish quartzite from other pebbles suitable for the manufacture of a tero-watta. But even if in special cases somewhat doubtful, a single test would be sufficient to prove whether the material is suitable or not.

Having proved that these specimens must be considered as tested rejects, we will now examine the percussion marks somewhat more closely, because none of the nuclei of finished tero-watta presents similar marks, except in cases of an ineffective blow. Even in that case there is a slight difference between the marks of an ineffective blow produced on hornstone and those of the effective blows on the pseudonuclei.

Exactly the same percussion mark can be produced if a well-tempered nail is placed on the surface of a quartzite pebble and a sharp blow is administered on its head. Of course it is absurd to assume that the aborigines used a nail or other sharply-pointed iron chisel to split the pebbles, but it may be probable that they placed the sharp point of a piece of rock on the pebble, and administered a sharp blow to this chisel.

However tempting it may be to assume, that the aborigines had learnt to split pebbles by means of a kind of chisel, I do not think that such a theory is in harmony with all the other facts we know as to their state of civilisation. I rather feel inclined to think that these peculiar deeply penetrating marks of percussion showing an intensive pulverising of the matrix are in some way connected with the physical constitution of the rock. With all reserve I may advance the view that the homogeneous hornstone is less elastic than the saccharine quartzite, and that while the former readily fractured when subjected to a blow coming under the effective angle, the latter resisted more strongly to the fracturing energy, and this resistance resulted in a deeper penetration of hammer into the matrix than would have taken place had the rock readily yielded to fracture.

(C) THE UNFINISHED REJECTS.

The evidence deduced from these specimens will come under the following heading, as it is essentially the Indical face that shows marks of being wrought.

5. EVIDENCE OF THE INDICAL FACE.

If we examine a large number of tero-watta we always find a number of specimens whose Indical face is more elaborately worked than that of others. We also perceive that these specimens are distinguished by a smooth, level Pollical face. So far I have not found a single specimen which has an elaborately wrought Indical, and a rough, uneven Pollical face. We may find specimens having a nice smooth Pollical face, whose Indical face shows hardly an traces of being trimmed, but we will never find a rough Pollical face combined with an elaborately chipped Indical face.

This fact proves conclusively that the production of a good, smooth, level, Pollical face was an essential feature in the manufacture of a tero-watta. Only such flakes that possessed this quality were further wrought, should they otherwise be considered as suitable.

It is obvious that the trimming of the Indical face was only necessary when the flake showed considerable thickness, and was, therefore, unhandy. In most cases the external flakes will have been submitted to this process, while the internal flakes, which were mostly of smaller thickness, did not require further reduction.

The trimming of the Indical face was invariably carried out in such a way that the blows were directed from the Pollical towards the Indical face, but never in the reverse way. This is another essential feature in the manufacture of the tero-watta, and R. M. Johnston (1) was the first who drew attention to this fact. There is no doubt that a good deal of unnecessary controversy in discussing the nature of the European archæolithes would have been avoided had Johnston's observation not been entirely overlooked. The fact he established as far back as 1888 had to be rediscovered, so to say, by Verworn (2) in 1908.

When the Indical face was trimmed it apparently happened not unfrequently that the blows did not have the desired effect. If it became impossible to reduce the thickness, the flake was rejected, no matter how much work had already been spent on it. One of the finest instances of this type that has come to my notice is the magnificent specimen found at Mona Vale. Its large thickness, 78 mm., and its weight of 3½lb., make it a most unwieldly tool, and it would require a giant's hand to grip and handle it (3).

Now, I observed that every time, when a tero-watta showed great thickness, the sides of the Indical face formed an angle of 80deg. to 90deg. with the Pollical face, while in those whose Indical face was well wrought the sides formed an angle of 45deg. to 60deg. with the Pollical face. This observation further confirms the view expounded in a previ ous paper that the effective angle under which the blow must strike the rock must be about 45deg. If it was impossible to direct the blows at this angle, it was also impossible to detach further flakes, thus reducing the thickness of the tero-watta, and the specimen was rejected as useless. Generally speaking, these unused rejects can be recognised by a saw-like edge, showing no marks of use.

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(1) Geology of Tasmania, 334.

(2) Ein objectives Kriterium fuer die Beurtellung der Manufactnatur geschlagener Feuersteine, Zeitsch, f. Ethnol, Heft. 4, 1908, pags 548 (page 555).

(3) The weight of this specimen appears more striking still if we bear in mind that 74.6 per cent. of tero-watta weigh under 8 ounces, while only 1.3 per cent. weigh more than 3lb.

6. EVIDENCE OF THE MARGINAL CHIPPING.

In a previous paper I pointed out that the origin of sharpening the edges of a flake was probably due to the peculiarity of homogeneous siliceous rocks, to produce sometimes a rounded instead of a sharp, cutting edge when the flake was struck off the parent block (1).

Now, though it is pretty certain that the flakes were struck off from the parent block by means of a spherical or globular hammer-stone, sometimes of considerable weight, it is very difficult to assume that the delicate and regular marginal trimming was done with such an implement. When I find a flake of 70 mm. in length, having a thickness of 2.3 mm. only, whose edge is most carefully and delicately worked by chipping off small regular flakes, I wonder whether this work can be done by means of a clumsy, globular stone?

If it was done in this way, the Tasmanian aborigines must have been exceedingly dexterous in wielding the hammer-stones, because the marginal flakes have often been struck off in such a regular manner that it required the greatest accuracy to direct the blow. To a modern mind it seems almost incredible that such regular delicate work could be done by means of a rough, clumsy hammer; yet, as we will presently see, it was done in such a way. We know that in the higher palæolithic stages the finer trimming of the implements was done by means of a special instrument, made of bone, by which thin flakes were pressed off. As the use of bone for implements was unknown to the Tasmanians, it is highly improbable that they applied such an instrument for the finer trimming of the tero-watta (2). We may, therefore, dismiss this theory at once.

Another theory, which is strongly supported by Dr. Rutot, assumes that the marginal chipping of the European archæolithes was done by means of a sharp-edged hammer, which he calls "tranchet" or "retouchoir." This may have

(1) This feature is, I may say, not limited to the Tasmanian hornstones, etc., but seems to be common to all homogeneous siliceous rocks having a conchoidal fracture. Among the specimens from Chelles which Dr. Rutot kindly sent me, I found a flint flake whose edge was rounded off exactly in the same way as exhibited by some tero-watta.

(2) I may add that if the aborigines had used such an instrument, it would not have escaped such an acute observer as the late Mr. Scott, and we certainly would have found pieces of bone indicating that they were used for such a purpose.

been so or not; I am not in a position to decide one way or other. Probably Dr. Rutot is quite right, but, unfortunately, we cannot say with certainty whether such an implement was used by the Tasmanians or not.

We have it from an eye-witness that they were "chipping one flint with another." We know that in certain instances the "flint" used as a hammer was a spherical diabase pebble, but, unfortunately, we do not know whether Scott's "flint" which was used as a hammer was such a diabase pebble, or whether it can be interpreted as a tero-watta made of hornstone, serving as a "retouchoir."

As already stated, it seems very improbable—at least to the modern mind—that a clumsy diabase pebble was used for the delicate marginal chipping and a priori it would seem more probable that another implement which could be handled with greater accuracy than a pebble was used. We will now investigate whether there is evidence to show that this was the case.

There is a certain group of tero-watta which are distinguished by a curious jagged saw-like edge. As the implement known as "saw" was unknown to the aborigines, though they unquestionably executed sawing movements when cutting a stick or a spear, we may dismiss the view that these tero-watta represent saws. What is more, they do not show any traces of use, the "teeth" of the edge being quite sharp and pointed. A closer examination proves that the blows which detached the flakes between the teeth were not placed quite close to each other, but at certain intervals. This view is fully borne out by a specimen from Brighton, which distinctly shows the traces of three blows placed in the way here described. Now, it is unquestionable that a number of blows, which are not close to each other, can be executed by means of a spherical hammer, as I have convinced myself by experiment. If, then, a second series of blows is directed against the same edge, by which the jagged points are removed—and it will be noticed that again these blows are not placed close to each other—the edge became perfectly sharp, and the flakes appear to be struck off with that regularity which appears so astonishing to us.

We see, therefore, that it is not necessary to use a sharp-edged hammer for marginal trimming, and that this can be done equally well by means of a spherical hammer in the way here described. The specimens showing a saw-like edge have, therefore, to be considered as unfinished rejects, and I feel obliged to withdraw the view first promulgated by me in a previous paper that sharply-edged stones were used for marginal trimming (1).

It is greatly to be regretted that Scott never inquired into the nature of the "flint" used as a hammer; if he had all the above speculations would not have been necessary.

7. EVIDENCE OF WEIGHT AND SIZE.

I weighed and measured 75 tero-watta which I selected at random from a large collection. All specimens were perfect, but it is more than probable that some of the largest specimens, patricularly the Mona Vale specimen, represent unfinished rejects, which should not properly be included among the implements actually used. I further took great care that none but tero-watta that had actually been used were examined. I admit that 75 specimens is a small number only, but I do not think that much would have been gained by weighing and measuring a larger number.

A.—WEIGHT.

The heaviest specimen weighed 3lb. 8oz., but this must in all probability be considered as an unfinished reject. The lightest specimen weighed not more than 96 grains, yet it showed distinct marginal chipping. The results are summarised in the following table:—

2 ounces and under: 20 specimens, equal to 26.6 per cent.

2 ounces to 4 ounces: 24 specimens, equal to 32 per cent.

4 ounces to 8 ounces: 12 specimens, equal to 16 per cent.

8 ounces to 1lb.: 8 specimens, equal to 10.6 per cent.

1lb. to 2lb.: 7 specimens, equal to 9.3 per cent

2lb. to 3lb.: 3 specimens, equal to 4.0 per cent.

More than 3lb.: 1 specimen, equal to 1.3 per cent.

(1) Stud. ueb d. Technik der tasm. Tronatta Arch. f. Anthropol. N.F., Vol. VIII. Heft 3, page 204.

This table presents some striking features; 56 tero-watta (74.6 per cent.) weigh under eight ounces; only 19 (25.2 per cent.) are above that weight, and even in that small number there are included specimens which, strictly speaking, should not have been mentioned. However that may be, these figures prove conclusively that the tero-watta was an implement of light weight, and as such it was not particularly suitable for any heavy work This view is still more emphasised if we consider that 44 specimens (58.6 per cent.), that is to say, considerably over one-half, weigh under 4 ounces.

The above figures make it appear that the largest number, viz., 24, equal to 32 per cent., weigh from 2 to 4 ounces, the lighter, but particularly the heavier weights, declining rapidly in number. Now, if we assume that the most suitable weight was from 2 to 8 ounces, we have:—

(a) 2 ounces and under: 20 specimens, equal to 26.6 per cent.

(b) 2 ounces to 8 ounces: 36 specimens, equal to 48.0 per cent.

(c) More than 8 ounces: 19 specimens, equal to 25.2 per cent.

The proportion of these three classes is rather remarkable, as we have:—

a: b: c equal to 1: 2: 1.

And I do not think that it is purely accidental. As I stated above, I selected the specimens at random, and if we find the examination of 75 specimens proves that out of 4 tero-watta 2 weigh between 2 and 8 ounces, while one is above and one below that weight, we must conclude that this really represents the true proportion.

B.—SIZE.

The largest specimen I found measures 206 mm. in length, while the smallest measures not more than 24 mm. Specimens measuring over 100 mm. (4-inch) represent only 30.6 per cent., while 69.4 per cent. remain under that size. Only 6 specimens that are under 100 mm. in length weigh more than 4 ounces, but none of them weigh more than 7 ounces. We have, therefore:—

Length more than 100 mm.: 22 specimens, equal to 30.6 per cent., weighing all more than 4 ounces.

Length less than 100 mm.: 53 specimens, equal to 69.4 per cent., almost all weighing under 4 ounces.

We can, therefore, say, with a great amount of accuracy, that in round figures half of all the tero-watta weighed from 2 to 8 ounces, and, with very few exceptions, remained under 100 mm. (4-inch) in length. One-quarter weighed more than 8 ounces and exceeded 100 mm. in length, while those that weighed less than 2 ounces never exceeded 75 mm. in length.

The above figures have conclusively demonstrated that the average tero-watta is a light implement of small size. Of course, there are exceptions, but they are few, and do not materially alter this view. The inference we can, therefore, draw is that the tero-watta was not an implement meant for heavy work. It was fit for light work only, and its size confirms, therefore, the view that it was used for chiefly in the manufacture of the wooden spears and throwing-sticks. A few other light manipulations, such as cutting the hair, the production of ornamental scars, scraping the red ochre, could be performed with it, and occasionally it was used as a knife to cut up animals. Heavier work, for instance, the splitting of fern trees, the cutting of notches into the bark of trees to be ascended, was probably done with columnar pieces of diabase, though it is probable that the heavier tero-watta may have also come in use for this kind of work.

Another very probable inference is that the hand which wielded the tero-watta was small, and that, therefore, the body to which this hand belonged was not of gigantic proportions.

8. SUMMARY AND CONCLUSIONS.

The above observations and facts can be summarised as follows:—

1. The raw material required for the manufacture of tero-watta was for the greater part obtained in the shape of water-worn pebbles from the gravel beds, for the smaller part from so-called quarries.

2. The raw material used in the manufacture of tero-

watta consisted exclusively of siliceous rocks of homogeneous nature possessing a good conchoidal fracture.

3. The parent block was broken by means of a hammer-stone; there is no definite evidence to show that the parent block rested on a hard support (anvil-stone) while being broken, but it is practically certain that the flakes were held in the hand when being trimmed.

4. The hammer-stones consisted chiefly of spherical or globular diabase boulders or pebbles, weighing from 1lb. to 2lb. in the average, though lighter, as well as heavier, ones, may have been occasionally used. The view that sharp-edged hammers of hornstone were employed, though not impossible, is not supported by actual evidence.

5. If anvil-stones were used—a theory which is more than doubtful—it is not probable that flakes of the same material from which the tero-watta were manufactured were employed. The only objects that could have served as anvil-stones are some of the indented stones described as "magic-stones," but the arguments against this view are so weighty that stronger evidence would be required before it could be accepted. In fact, all the evidence rather goes to disprove the use of anvil-stones than to prove it.

6. The blow of the hammer divides the parent block into nucleus (core) and flake (flakes, spalls).

7. Besides the true nuclei, i.e., pieces of stone which were left behind after the flake (flakes) had been detached, there are pseudo-nuclei, that is to say, boulders which were merely tested as to their quality, and rejected as unsuitable.

8. The marks of percussion on the pseudo-nucleus—a rather deep hole and intense shattering of the matrix—make it appear as if a sharply-pointed hammer had been used. This is not very likely, and the peculiarity of the marks is in all probability due to the physical constitution of the rock.

9. The flakes can be divided into external and internal flakes, and each group is again divided into two subgroups.

10. In the external flakes the original crust of the parent block (or part thereof) forms the Indical-face.

11. In the internal flakes one or more previous planes of fracture form the Indical face.

12. External and internal flakes of the first order have no special percussion face; the latter is formed by the original surface of the parent block.

13. External and internal flakes of the second order have a special percussion face (a former plane of fracture) which, though sometimes greatly reduced by marginal trimming, forms an angle of about 135deg. with the Pollical face.

14. The production of a flat, smooth Pollical face was the essential feature in striking off a flake from the parent block. This condition could only be fulfilled if the hammer struck the parent block at an angle of about 45deg.

15. The future shape of the tero-watta was primarily determined by the shape of the orginal flake.

16. A flake detached from a parent block may have been used without further trimming or not. If it was the Indical face only was worked, but never the Pollical face. (N.B.—There are certain exceptions of this rule, mostly in such instances when in the case of an internal flake there was little difference between Indical and Pollical face.)

17. Invariably the trimming of the Indical face or the edges was done by blows from the Pollical towards the Indical face, and never vice versa. (N.B.—There are certain exceptions, but they do not materially affect this rule.)

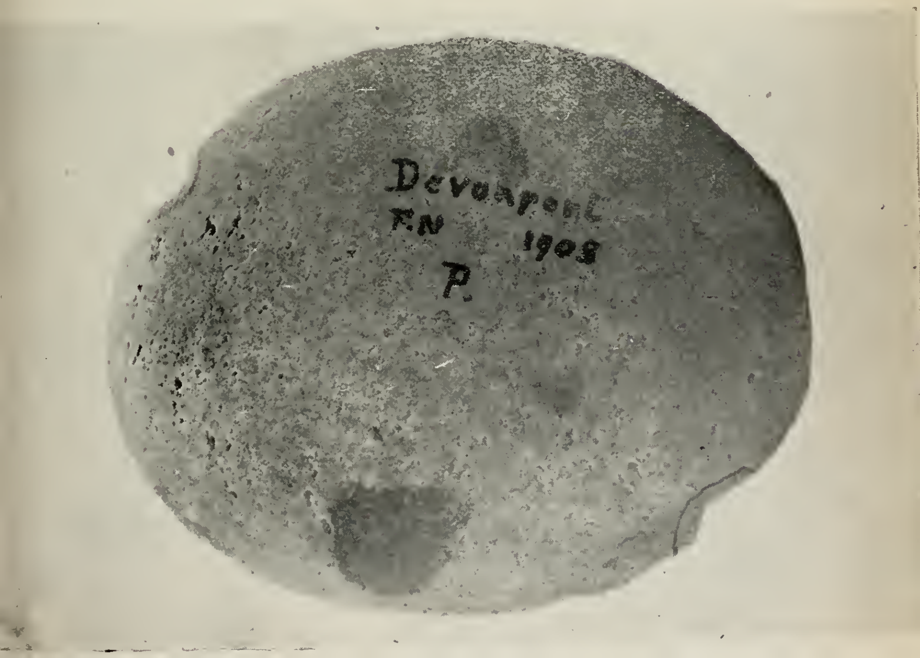
18. The trimming of the Indical face or the edges was in all probability done by means of a spherical hammer. In marginal trimming the blows were not set close, but at regular intervals, the saw-like edge thus resulting was subsequently straightened by striking of the "teeth."

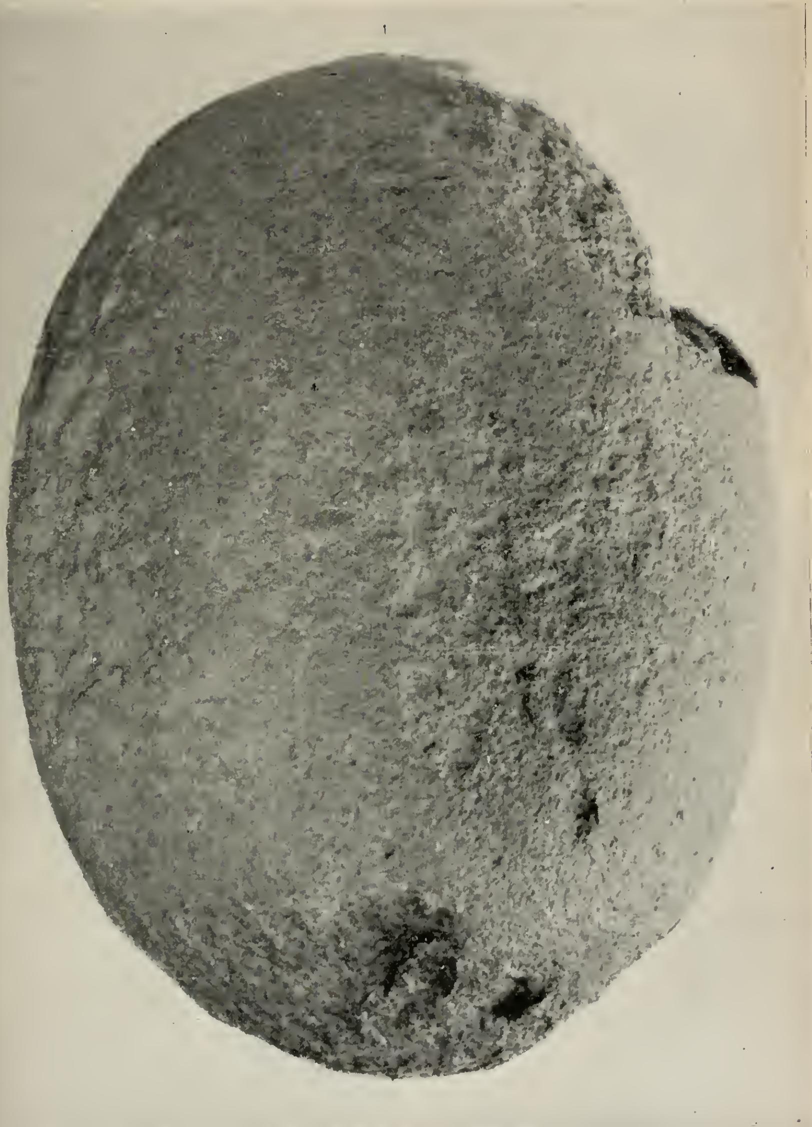
19. In round figures 75 per cent. of the finished tero-watta weighed under 8 ounces, while only 25 per cent. weighed more than 8 ounces. The largest number, 32 per cent., weighed between 2 and 4 ounces, while only 14 per cent., a good number of which are perhaps unfinished rejects, weighed more than 1lb.

NUCLEUS.

TESTED REJECT.

TESTED REJECT.





HAMMER STONE (?)

20. There is reason to believe that there was a desire to produce a flake of a certain weight and size, irrespective of shape, when a parent block was broken, no matter how suitable the other flakes that fell off may have been, but the Indical face, particularly of external flakes, may have been subsequently trimmed. The inability to trim the Indical face probably accounts for the large number of unfinished rejects.

21. The accidental marks of percussion resulting when the flake was struck off the parent block appear on the Pollical face only, and their negatives can be seen on the core. (Any marks of percussion appearing on the Indical face are either the negatives of an earlier flake, or due to subsequent trimming.) These marks are: cone of percussion, scar of percussion, radiating fissure of percusssion, concentric wrinkles of percussion. The three first appear at the proximal end, while the last may spread over the whole surface. The process of percussion appears at the edge between Percussion and Pollical face, and marks the point where the blow fell.

22. If a wrinkle of percussion coincides with the edge of a flake, the edge is rounded instead of sharp, and this gave probably rise to marginal sharpening by striking off small flakes along the edge.

23. Though the essential character of the tero-watta is its unsymmetry in two directions, there is good reason to believe that certain specimens show an intentional outline, produced by marginal trimming.

24. There is no evidence to show that the tero-watta were manufactured in advance of their use; in all probability they were only manufactured when required, and immediately discarded afterwards.

25. It appears that sometimes attempts were made to rechip a previously discarded tero-watta, but there is no evidence to show that these attempts were completed.

26. The tero-watta was a universal instrument, adapted for all purposes alike, but never used as a weapon.

27. The reasons given under 24 and 26 explain the enormous frequency of the tero-watta.